

Appendix B1 – Human Health Risk-Based Preliminary Remediation Goal (PRG) Derivation

1.0 Introduction

This section presents the calculation of risk-based preliminary remediation goals in sediment and biota. Risk-based PRGs were calculated for all contaminants that posed an excess lifetime cancer risk greater than 1×10^{-6} or a hazard quotient greater than 1 in the final Portland Harbor Baseline Human Health Risk Assessment (Kennedy/Jenks 2013) assuming reasonable maximum exposure. For cancer effects, risk-based PRGs were calculated as the concentration consistent with a specified target excess cancer risk (TR) of 1×10^{-6} . For non-cancer effects, the risk-based PRGs were the calculated concentration that would result in a specified target hazard quotient (THQ) of 1. For both cancer and noncancer effects, the PRGs are calculated based on specified exposure pathways and receptors. Exposure values are summarized in Table 1, and unless otherwise noted, the source for each value is provided in Tables 3-21 through 3-25 in the Final Portland Harbor BHHRA.

1.1 PRGs for Direct contact with Sediment

Risk-based PRGs based on direct-contact pathways with sediment are calculated to account for incidental ingestion and dermal exposures. These values are then combined to derive a single risk-based PRG protective of both exposure pathways.

1.1.1 Incidental Ingestion of Sediment

Risk-based PRGs associated with the incidental ingestion of sediment were calculated for child or adult receptors as appropriate using the following equations adapted from Section 3.5.1 of the Final BHHRA:

Noncancer effects:

$$PRG_{\text{sed-nc}} = \frac{THQ \times BW \times AT_{nc}}{EF \times ED \times \frac{1}{RfD} \times IRS \times 10^{-6} \text{ kg / mg}}$$

Carcinogenic effects:

$$PRG_{\text{sed-c}} = \frac{TR \times BW \times AT_c}{EF \times ED \times CSF \times IRS \times 10^{-6} \text{ kg / mg}}$$

Risk-based PRGs based on carcinogenic effects, and where exposure was assumed to occur from childhood through adult years were age-weighted using the following equation:

$$PRG_{sed-c} = \frac{TR \times AT_c}{CSF \times EF \times IFS_{adj} \times 10^{-6} \text{ kg / mg}}$$

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{ED_a \times IRS_a}{BW_a}$$

and:

- PRG_{sed} = risk-based PRG in soil or sediment (µg/kg or mg/kg)
- IFS_{adj} = age-adjusted soil/sediment incidental ingestion factor [(mg-year)/(kg-day)]
- IRS_a = incidental sediment ingestion rate-adults (mg/day)
- IRS_c = incidental sediment ingestion rate-children (mg/day)
- EF = exposure frequency (days/year)
- ED_a = exposure duration – adult (years)
- ED_c = exposure duration – child (years)
- BW_a = body weight – adult (kg)
- BW_c = body weight – child (kg)
- AT_{nc} = averaging time, noncancer (days)
- AT_c = averaging time, cancer (days)
- THQ = target hazard quotient
- TR = target excess cancer risk
- CSF = cancer slope factor (mg/kg-day)⁻¹

The following equation was used to calculate risk-based PRGs in sediment for contaminants known to be mutagenic (cPAHs), and incorporates the age-dependent adjustment factors (ADAFs) of 10 and 3, respectively, for exposures occurring before 2 years of age and from ages 2 through 16 (see section 3.5.7 of the BHHRA):

$$PRG_{sed-m} = \frac{TR \times AT_c}{EF \times CSF \times ISIFM_{adj} \times 10^{-6} \text{ kg / mg}}$$

$$ISIFM_{adj} = \left(\frac{(ED_{0-2} \times IRS_c) \times 10}{BW_c} + \frac{(ED_{2-6} \times IRS_c) \times 3}{BW_c} + \frac{(ED_{6-16} \times IRS_a) \times 3}{BW_a} + \frac{(ED_{16-30} \times IRS_a) \times 1}{BW_a} \right)$$

where:

- PRG_{sed} = chemical concentration in soil or sediment (mg/kg)
- IRS_a = adult soil/sediment ingestion rate (mg/day)
- IRS_c = child soil/sediment ingestion rate (mg/day)
- ISIFM_{adj} = incidental sediment ingestion factor for mutagens (mg-yr/kg-day)
- EF = exposure frequency (days/year)

ED ₀₋₂	= exposure duration ages 0-2 (years)
ED ₂₋₆	= exposure duration ages 2-6 (years)
ED ₆₋₁₆	= exposure duration ages 6-16 (years)
ED ₁₆₋₃₀	= exposure duration ages 16-30 (years)
BW _a	= adult body weight (kg)
BW _c	= child body weight (kg)
AT _c	= averaging time, carcinogens (days)
CSF	= cancer slope factor (mg/kg-day) ⁻¹
RfD	= reference dose (mg/kg-day)
THQ	= target hazard quotient
TR	= target excess cancer risk

The exposure assumptions are provided in Table 1.

1.1.2 Dermal Contact with Sediment

Risk-based PRGs for dermal contact with sediment were calculated for child or adult receptors as appropriate using the following equations adapted from Section 3.5.2 of the Final BHHRA:

Non-cancer effects:

$$PRG_{sed} = \frac{THQ \times AT_{nc} \times BW}{EF \times ED \times \frac{1}{RfD} \times SA \times AF \times ABS \times 10^{-6} \text{ kg / mg}}$$

Cancer effects:

$$PRG_{sed} = \frac{TR \times AT_c \times BW}{EF \times ED \times CSF \times SA \times AF \times ABS \times 10^{-6} \text{ kg / mg}}$$

Combined child and adult age-weighted exposures resulting from dermal contact with contaminants in sediment for the recreational beach user exposure scenarios were calculated consistent with the following equations:

$$PRG_{sed} = \frac{TR \times AT_c}{CSF \times EF \times DFS_{adj} \times 10^{-6} \text{ kg / mg}}$$

where:

$$DFS_{adj} = \frac{ED_c \times EF_c \times AF_c \times SA_c}{BW_c} + \frac{ED_a \times EF_a \times AF_a \times SA_a}{BW_a}$$

and:

PRG _{sed}	= concentration in soil or sediment (µg/kg or mg/kg)
DFS _{adj}	= age-adjusted dermal contact factor [(mg-year)/(kg-day)]
ABS _{dermal}	= dermal absorption efficiency

SA _a	= exposed skin surface area – adult (square centimeters [cm ²])
SA _c	= exposed skin surface area – child (cm ²)
AF _a	= soil-to-skin adherence factor – adult (mg/cm ²)
AF _c	= soil-to-skin adherence factor – child (mg/cm ²)
EF	= exposure frequency (days/year)
ED _a	= exposure duration – adult (years)
ED _c	= exposure duration – child (years)
BW _a	= body weight – adult (kg)
BW _c	= body weight –child (kg)
AT	= averaging time (days)
CSF	= cancer slope factor (mg/kg-day) ⁻¹
RfD	= reference dose (mg/kg-day)
THQ	= target hazard quotient
TR	= target excess cancer risk

Risk-based PRGs for cPAHs based on dermal exposure to sediments were also calculated as using the early-life exposure adjustments described in Section 1.1.3:

$$PRG_{sed} = \frac{TR \times AT}{EF \times CSF \times DSCFM_{adj} \times ABS \times CF}$$

Where:

$$DSCFM_{adj} = \left(\frac{ED_{0-2} \times AF_c \times SA_c \times 10}{BW_c} + \frac{ED_{2-6} \times AF_c \times SA_c \times 3}{BW_c} + \frac{ED_{6-16} \times AF_a \times SA_a \times 3}{BW_a} + \frac{(ED_{16-30} \times AF_a \times SA_a \times 1)}{BW_a} \right)$$

where:

PRG _{sed}	= chemical concentration in soil or sediment (mg/kg)
ABS _{dermal}	= dermal absorption efficiency
DSCFM _{adj}	= dermal sediment contact factor for mutagens (mg-yr/kg-day)
SA _a	= adult exposed skin surface area (square centimeters [cm ²])
SA _c	= child exposed skin surface area (cm ²)
AF _a	= adult soil-to-skin adherence factor (mg/cm ²)
AF _c	= child soil-to-skin adherence factor (mg/cm ²)
EF	= exposure frequency (days/year)
ED ₀₋₂	= exposure duration ages 0-2 (years)
ED ₂₋₆	= exposure duration ages 2-6 (years)
ED ₆₋₁₆	= exposure duration ages 6-16 (years)
ED ₁₆₋₃₀	= exposure duration ages 16-30 (years)
BW _a	= adult body weight (kg)
BW _c	= child body weight (kg)
AT	= averaging time (days)
TR	= target excess cancer risk

Exposure assumptions are presented in Table 2.

The individual pathway-specific calculations are combined to a total risk-based PRG in sediment using the following equation:

$$PRG_{sed} = \frac{1}{\frac{1}{PRG_{sed} - Ingestion} + \frac{1}{PRG_{sed} - dermal}}$$

1.2 Fish/Shellfish Tissue PRGs

Risk-based preliminary remediation goals (PRGs) are calculated for fish/shellfish tissue and for sediment. Tissue concentrations were calculated as they represent a direct exposure point for human receptors, and because target tissue concentrations are needed to derive sediment PRGs for protection of human health due to fish consumption.

1.2.1 Risk-Based Tissue PRGs for Direct Consumption

Risk-based tissue PRGs associated with consumption of fish and shellfish were calculated for resident fish using the following equations, adapted from Section 3.5.5 of the Final BHHRA:

Non-cancer effects:

$$PRG_{tissue} = \frac{THQ \times BW_c \times AT_{nc}}{ED_c \times EF \times \frac{1}{RfD} \times CR_c \times 0.001 \text{ kg / g}}$$

Carcinogenic effects:

$$PRG_{tissue} = \frac{TR \times BW_a \times AT_c}{ED_a \times EF \times CSF \times CR_a \times 0.001 \text{ kg/g}}$$

Combined child and adult exposure was evaluated consistent with the following equation:

$$PRG_{tissue} = \frac{TR \times AT_c}{EF \times CR_{adj} \times CSF \times 0.001 \text{ kg / g}}$$

where:

$$CR_{f-adj} = \frac{ED_c \times CR_c}{BW_c} + \frac{ED_a \times CR_a}{BW_a}$$

and:

PRG_{tissue} = risk-based concentration in fish/shellfish tissue (µg/kg, wet-weight)
 CR_c = consumption rate of fish/shellfish – child (g/day, wet-weight)

CR _a	=	consumption rate of fish/shellfish – adult (g/day, wet-weight)
CR _{f-adj}	=	consumption rate of fish/shellfish – age-adjusted (g/day – wet weight)
EF	=	exposure frequency (days/year)
ED _c	=	exposure duration – child (years)
ED _a	=	exposure duration – adult (years)
BW _c	=	body weight – child (kg)
BW _a	=	body weight – adult (kg)
AT _{nc}	=	averaging time, noncancer (days)
AT _c	=	averaging time, cancer (days)
CSF	=	cancer slope factor (mg/kg-day) ⁻¹ , see Table 2
RfD	=	reference dose (mg/kg-day), see Table 2
THQ	=	target hazard quotient
TR	=	target excess cancer risk

The exposure assumptions are presented in Table 1.

1.2.2 Risk-Based Tissue PRGs based on Infant Consumption of Breast Milk

Risk-based PRGs in fish and shellfish tissue were calculated using the following equation adapted from Section 3.5.6 of the Final Portland Harbor BHHRA. The equation presumes steady-state conditions where maternal intake via fish consumption occurs over a period greater than the biological half-life of the contaminant in the body. Maternal intake was modified slightly from the method presented in Section 1.1.1 by assuming a maternal body weight of 66 kg, representing an age-weighted value for women aged 15-44 years (ODEQ 2010), consistent with the value used in the Final Portland Harbor BHHRA.

$$PRG_{tissue} (\mu g/kg) = \frac{\left(\frac{THQ \times BW_{inf} \times AT_{inf} \times RfD}{f_{mbm} \times CR_{milk} \times ED_{inf}} \right) \times [\ln(2) \times f_{fm}] \times BW_m \times AT_{nc}}{(h \times f_f) \times EF_a \times ED_a \times 10^{-3} kg / g \times 10^{-3} mg / \mu g \times AE \times CR_{fish}}$$

where:

PRG _{tissue}	=	risk-based PRG in fish/shellfish (μg/kg – wet weight)
THQ	=	target hazard quotient
RfD	=	reference dose (mg/kg-day)
AE	=	absorption efficiency of the chemical
h	=	biological half-life of chemical in the body (days)
f _f	=	fraction of absorbed chemical stored in fat
f _{fm}	=	fraction of mother's weight that is fat
f _{mbm}	=	fraction of fat in breast milk
CR _{milk}	=	infant consumption rate of breast milk (kg/day)
CR	=	maternal consumption rate of fish (g/day)
ED _{inf}	=	exposure duration of breastfeeding infant (days)

EF _a	= exposure frequency – adult (maternal exposure, days/yr)
ED _a	= exposure duration – adult (days)
BW _{inf}	= average infant body weight (kg)
BW _m	= average body weight – maternal (kg)
AT _{inf}	= averaging time, infant exposure (days)
AT _{nc}	= averaging time, noncancer (days)

1.3 Calculation of Risk-Based PRGs in Sediment Based on Consumption of Fish/Shellfish

Target tissue concentrations were calculated using the method described in Section 1.1.1. To calculate sediment PRGs for scenarios where fish consumption is primarily the fillet, it was necessary to determine the relationship between whole body and fillet-only concentrations, because both the BSAFs/BSARs and the FWM are based on whole body concentrations. The whole-body/fillet concentration ratios were calculated using the measured mean whole body and fillet concentrations of each COC on a river mile or fishing zone basis, and are presented in Table 3.

Carcinogenic PAHs (cPAHs)

The Bioaccumulation Modeling Report (Windward, 2015) presented a calculated BSAR for benzo(a)pyrene in field clams as the following equation:

$$\ln(PRG_{sed}) = \frac{\ln(C_{tissue}) - \ln(CF) + 2.47}{0.60}$$

In order to calculate a PRG, the BSAR for benzo(a)pyrene was considered representative of total carcinogenic PAHs. Because the BSAR is based on lipid-normalized tissue and organic carbon normalized, corrections for site organic carbon and the lipid content of clams were incorporated to arrive at a dry-weight sediment concentration:

$$\ln(PRG_{sed}) = \left[\frac{(\ln(C_{tissue}) - \ln(f_{lipid})) - \ln(CF) + 2.47}{0.60} \right] + \ln(f_{oc})$$

And:

$$PRG_{sed} = e^{\left[\frac{(\ln(C_{tissue}) - \ln(f_{lipid})) - \ln(CF) + 2.47}{0.60} \right] + \ln(f_{oc})}$$

PRG _{sed}	= risk-based PRG in sediment, dry weight (µg/kg)
C _{tissue}	= risk-based target fish/shellfish tissue concentration – wet weight (µg/kg)
CF	= correction factor (2.31, see Table 4-1, Windward 2009)
f _{oc}	= fraction organic carbon site sediments, dry weight (0.0171)
f _{lipid}	= fraction of lipid in clam tissue, wet weight (0.22)

Hexachlorobenzene

Sediment-tissue BSAFs for hexachlorobenzene were developed for large home-range species, no relationship was established for smallmouth bass (Windward, 2015). The general relationship between sediment and tissue concentrations is expressed by the following equation:

$$PRG_{sed} = \frac{C_{tissue}}{BSAF}$$

Correcting for the organic carbon content of sediment and lipid content of fish gives the following equation:

$$PRG_{sed} = \frac{\left[\left(\frac{C_{tissue}}{f_{lipid}} \right) \times f_{oc} \right]}{BSAF}$$

where:

- PRG_{sed} = concentration in sediment, dry weight (µg/kg)
- f_{lipid} = lipid content of fish, wet weight (percent)
- f_{oc} = sediment organic carbon content, dry weight (0.0171)
- BSAF = biota-sediment accumulation factor (unitless)

BSAFs and percent lipid content used are 2.02 and 5.2 for black crappie, 0.0295 and 2.4 for brown bullhead, and 0.244 and 8.8 for carp.

As noted above, BSAFs were only developed for large home-range species, and not for smallmouth bass. Accordingly, target sediment concentrations (Conc_{sed}) were calculated for each species, and the risk-based sediment PRG for hexachlorobenzene was calculated using the following equation:

$$PRG_{sed} = \frac{1}{\frac{1}{Conc_{sed} - Crappie} + \frac{1}{Conc_{sed} - Carp} + \frac{1}{Conc_{sed} - Bullhead}}$$

1.4 PRGs calculated using the Food-Web Model

The Arnot and Gobas food-web model was refined for use at Portland Harbor (Windward, 2015), and accounts for uptake of contaminants via direct incidental ingestion, dietary uptake, and uptake of dissolved contaminants via ingestion and gill uptake. The FWM was calibrated for chlorinated persistent organic contaminants (aldrin, dieldrin, chlordane, DDX, PCBs, and five specific dioxin/furan congeners). Although the final BHHRA evaluated consumption of smallmouth bass, carp, brown bullhead, and

crappie, the latter two species are not evaluated in the FWM. The Largescale sucker was used as a surrogate for bullhead, and sculpin as a surrogate for crappie, as they were considered representative of the same trophic group (Windward, 2015). Oregon human health ambient water quality criteria (DEQ, 2011) for consumption of water and organism were initially used for the contaminant concentration in water. Because specific AWQC have not been established for individual dioxin/furan congeners, the value for 2,3,7,8-TCDD was used for the input water concentration for all dioxin/furan congeners

The calculated concentrations in whole body fish of each species were converted to fillet concentrations using the whole-body/fillet ratios presented in Table 4. The resulting fillet concentration were further combined as a weighted mean, with each species representing 25 percent of the total diet. The goal-seek function in Excel was then used to iteratively calculate a surface-weighted average sediment concentration that ultimately predicts the target average tissue concentration of the four modeled species. As noted above, Oregon AWQC were initially used to represent post-remedial surface water concentrations. However, in some instances this resulted in the calculation of a sediment PRGs less than zero. The mathematical explanation for this is that dissolved water concentrations alone are predicted to result in estimated tissue concentrations greater than the risk-based target. When this occurred, the water concentration was set to zero, and the target sediment concentration recalculated. This procedure was used for total PCBs, 2,3,7,8-TCDD, and 1,2,3,7,8-PeCDD where the sediment PRGs were calculated based on either a 1×10^{-6} target risk or infant exposure via breastfeeding.

1.5 REFERENCES

Kennedy/Jenks Consultants. 2013. Portland Harbor RI/FS, Final Remedial Investigation Report, Appendix F, Baseline Human Health Risk Assessment. Portland, OR. April 2013.

Oregon Department of Environmental Quality (ODEQ), 2010. Human Health Risk Assessment Guidance. Oct 2010

Oregon Department of Environmental Quality, 2011. Water Quality Standards for Toxic Pollutants, Table 40. OAR 340-041-0033

U.S. Environmental Protection Agency (EPA) 2004. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. Office of Emergency and Remedial Response. EPA/540/R/99/005. July 2004.

EPA 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,7-Tetrachlorodibenzo-*p*-dioxin and Dioxin-Like Compounds. EPA/100/R-10/005 December 2010

Windward. 2015. Portland Harbor RI/FS Bioaccumulation Modeling Report. Final. Prepared for the Lower Willamette Group, Portland, OR. Windward Environmental LLC, Seattle, WA.

Table 1: Exposure Values

Symbol	Description	Subsistence Fisher	Tribal Fisher	Recreational Beach Use	Dockside Worker	In-Water Worker	Infant Consumption of Breast milk
ABS _{dermal}	dermal absorption efficiency (unitless)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
ABS _{oral}	absorption efficiency (mg-yr/kg-day)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
AE	oral absorption efficiency (unitless)	--	--	--	--	--	1
AF _a	soil-to-skin adherence factor – adult (mg/cm ²)	0.3	0.3	0.3	0.2	0.2	--
AF _c	soil-to-skin adherence factor – child (mg/cm ²)	--	--	3.3	--	--	--
AT _{nc}	averaging time – noncarcinogenic effects (days)	ED x 365 d/yr	ED x 365 d/yr	ED x 365 d/yr	ED x 365 d/yr	ED x 365 d/yr	ED x 365 d/yr
AT _c	averaging time – carcinogenic effect (days)	25,550	25,550	25,550	25,550	25,550	--
AT _{inf}	averaging time – infant exposure (days)	--	--	--	--	--	365
BW _a	body weight – adult (kg)	70	--	70	70	70	70
BW _m	body weight – maternal body weight, kg	66	66	66	66	66	--
BW _c	body weight – child (kg)	15	--	15	--	--	--
BW _{inf}	average infant body weight (kg)	--	--	--	--	--	7.8
CR _a	consumption rate of fish/shellfish – adult (g/day, wet-weight)	142/3.3	--	--	--	--	142
CR _c	consumption rate of fish/shellfish – child (g/day, wet-weight)	60/--	--	--	--	--	--
CR _{milk}	infant consumption rate of breast milk (kg/day)	--	--	--	--	--	0.98
ED ₀₋₂	exposure duration ages 0-2 (years)	--	--	2	--	--	--
ED ₁₆₋₃₀	exposure duration ages 16-30 (years)	--	--	14	--	--	--
ED ₂₋₆	exposure duration ages 2-6 (years)	--	--	4	--	--	--
ED ₆₋₁₆	exposure duration ages 6-16 (years)	--	--	10	--	--	--
ED _a	exposure duration – adult (years)	30	70	30	25	10	--
ED _c	exposure duration – child (years)	6	--	6	--	--	--
ED _{inf}	exposure duration of breastfeeding infant (days)	--	--	--	--	--	365
EF _a	exposure frequency – adult (days/year)	350/156 ^a	260	94	50	10	350
f _f	fraction of absorbed chemical stored in fat	--	--	--	--	--	0.9
f _{fm}	fraction of mother's weight that is fat	--	--	--	--	--	0.3
f _{mbm}	fraction of fat in breast milk	--	--	--	--	--	0.04
h	biological half-life of chemical in the body (days)	--	--	--	--	--	See Table 3
IRS _a	incidental sediment ingestion rate-adults (mg/day)	100	100	100	--	200	--
IRS _c	incidental sediment ingestion rate-children (mg/day)	--	--	200	--	--	--
SA _a	exposed skin surface area – adult (cm ²)	1,980/5,700 ^b	1,980/5,700	5,700	3,300	3,300	--
SA _c	exposed skin surface area – child (cm ²)	--	--	2,800	--	--	--
THQ	target hazard quotient	1	1	1	1	1	1
TR	target cancer risk	1 x 10 ⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁶	--

a – 350 days/year fish consumption and 156 days/year sediment contact while fishing

b – beach/in-water sediment

Table 2: Chemical-Specific Values

Chemical	SF (mg/kg-day) ⁻¹	Source	RfD (mg/kg-day)	Source	Infant RfD (mg/kg-day)		h (days)	Source	ABS	
Antimony			4.0E-03	IRIS						
Arsenic	1.5E+00	IRIS	3.0E-04	IRIS					0.03	EPA 2004
Mercury			1.0E-04	IRIS						
cPAHs (as benzo(a)pyrene	7.3E+00	IRIS	3.0E-04	IRIS					0.13	EPA 2004
Bis(2-ethylhexyl)phthalate	1.4E-02	IRIS	2.0E-02	IRIS					0.1	EPA 2004
Aldrin	1.7E+01	IRIS	3.0E-05	IRIS					0.1	EPA 2004
Dieldrin	1.6E+01	IRIS	5.0E-05	IRIS					0.1	EPA 2004
Chlordane	3.5E-01	IRIS	5.0E-04	IRIS					0.04	EPA 2004
DDx	3.4E-01	IRIS	5.0E-04	IRIS			120	ODEQ ^a	0.03	EPA 2004
Hexachlorobenzene	1.6E+00	IRIS	8.0E-04	IRIS					0.1	EPA 2004
Pentachlorophenol	4.0E-01	IRIS	5.0E-03	IRIS					0.25	EPA 2004
PCBs	2.0E+00	IRIS	2.0E-05	IRIS	3.0E-05	ODEQ	2555	ODEQ	0.14	EPA 2004
PDBEs			1.0E-04	IRIS	1.0E-04	IRIS	2555	ODEQ	0.14	EPA 2004
1,2,3,4,7,8-HxDCF	1.3E+04 ^b	IRIS	7.0E-09	IRIS	7.0E-09	IRIS	2550	ODEQ	0.03	EPA 2004
1,2,3,7,8-PeCDD	1.3E+05	IRIS	7.0E-10	IRIS	7.0E-10	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,4,7,8-PeCDF	3.9E+04	IRIS	2.3E-09	IRIS	2.3E-09	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,7,8-TCDF	1.3E_04	IRIS	7.0E-09	IRIS	7.0E-09	IRIS	2550	ODEQ	0.03	EPA 2004
2,3,7,8-TCDD	1.3E+05	IRIS	7.0E-10	IRIS	7.0E-10	IRIS	2550	ODEQ	0.03	EPA 2004
IRIS – US EPA Integrated Risk Information System www.epa.gov/iris a – ODEQ 2010 Appdenix D b – CSF and RfDs for congeners other than 2,3,7,8-TCDD calculated using the TEF methodology in EPA 2010										

a

Table 3
Whole Body/Fillet Contaminant Ratios

	Smallmouth Bass	Carp	Black Crappie	Brown Bullhead
Aldrin ^a	5.77	1.36	12	10.46
Chlordane	5.92	1.4	12	10.46
Dieldrin	5.77	1.36	12 ^b	10.46 ^b
DDx ^c	7.17	1.42	6.32	4.06
PCBs	8.02	1.82	5.46	1.56
Total Dioxins/Furans	6.13	1.52	6.13	1.52

a – not measured, based on dieldrin
b – not measured, based on chlordane
c – average of DDD, DDE, and DDT